VALUE IN HEALTH 15 (2012) 1077–1083

Available online at www.sciencedirect.com

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Contingent Valuation Scenarios for Chronic Illnesses: The Case of Childhood Asthma

Sylvia Brandt, PhD[1,], Felipe Vásquez Lavín, PhD[2], Michael Hanemann, PhD[3]*

[1]*Department of Resource Economics, University of Massachusetts, Amherst, Amherst, MA, USA;* [2]*School of Business and Economics, Universidad del Desarrollo, Concepción, Chile;* [3]*Professor & Julie A. Wrigley Chair in Sustainability, Department of Economics, Arizona State University, Tempe, AZ, USA*

ABSTRACT

Objectives: We use a contingent valuation (CV) study of childhood asthma to discuss a central issue in designing CV studies of chronic illness—the need for a detailed, realistic scenario that minimizes confounding factors—and show how to address this issue. We apply our methodology to estimate households' willingness to pay (WTP) for reductions in asthma morbidity. **Methods:** By using a combination of focus groups, revealed preference surveys, and epidemiological surveys, we gathered information on health status, attitudes, and beliefs regarding asthma, risk-averting behaviors, perceptions of these behaviors, and household socioeconomic characteristics. We used this information to design a CV survey that we extensively tested for validity. In the survey, we elicited participants' WTP for a hypothetical device that would reduce symptom-days by improving asthma management; these data enabled us to estimate household WTP by using a variety of econometric models. **Results:** Our analysis of households with children with asthma yielded the following conclusions: the scenario should address both physical asthma symptoms and the psychosocial stress of managing a chronic illness; the survey should measure household perceptions of the burden of asthma in addition to objective measures such as symptom-days; and the scenario should not involve substantial behavioral changes or a new medication, to avoid confounding household preferences with unrelated attributes of the scenario. Our primary models estimated mean household WTP for a 50% reduction in symptom-days (and accompanying reductions in psychosocial stress) at $56.48 to $64.84 per month. **Conclusions:** Our methodology can be used to inform CV studies of chronic illness. Our WTP estimates can help regulatory agencies assess a wide range of policies that affect the incidence or severity of asthma.

Keywords: asthma, attitudes and beliefs, chronic illnesses, contingent valuation, quality of life.

Introduction

Globally, more than 300 million people suffer from asthma, leading to approximately 15 million disability-adjusted life-years annually; an estimated 1 in every 250 deaths internationally is due to asthma [1]. In the United States, the cost of asthma was more than $37 billion in 2007 [2]. More generally, chronic illnesses are internationally the leading cause of mortality and disease burden [3], costing approximately $1.5 trillion annually in the United States [4].

Developing accurate tools for valuing changes in chronic illness is a high priority for health economics. In this article, we discuss a central design issue in valuing chronic illness and address this issue in the context of childhood asthma. To capture the total welfare impact of asthma on households, we chose the contingent valuation (CV) method over alternatives such as the cost-of-illness approach or the revealed preference method. We estimated a parent's willingness to pay (WTP) to reduce her child's asthma morbidity by surveying participants in an epidemiological study of children's asthma, combining data on households with a revealed preference survey and the CV survey. To ensure that the WTP values we estimated were most informative for policy and program evaluation, we administered the CV survey to parents whose children currently have asthma symptoms and we specified that respondents would pay out of pocket for the hypothetical good. Thus, our data correspond to the privately financed, private goods scenario (described by Shackley and Donaldson [5]) and are appropriate for our suggested uses.

Because household quality of life is affected by both physical asthma symptoms and uncertainty about when an attack might occur, a valuation scenario should reduce both the frequency of asthma episodes and the accompanying psychosocial stress. The survey should measure the household's perception of its asthma burden in addition to objective data such as the number of symptom-days. Finally, the scenario should not require substantial behavioral changes or new medications, so that stated values do not reflect unrelated household preferences.

To promote the development of guidelines for health valuation, we describe the design of the survey as well as the model results. We used our WTP estimates to test the validity of the

* *Address correspondence to*: Sylvia Brandt, Department of Resource Economics, 205A Stockbridge Hall, University of Massachusetts, Amherst, MA 01003.

E-mail: sylvbrandt@gmail.com.

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http://dx.doi.org/10.1016/j.jval.2012.07.006

scenario. Our estimates can be used for multiple policy analyses, ranging from cost-benefit analyses of air quality regulations to evaluations of health programs.

Previous Literature

Contingent valuation is a methodology for valuing changes in health status. CV arose in the environmental economics literature as an approach to overcome the lack of markets for public goods [6]. There have been more than 1500 applications of CV, many dealing with environmental goods [7]. CV has increasingly been applied to the valuation of health outcomes and regulatory review of health policies [8,9]; however, previous authors have noted that the overall quality of CV health studies is disappointing [8,10]. Policymakers have specifically noted the need for a valuation of the burden of child asthma [10].

The validity of a CV study depends on the quality of the hypothetical scenario, which should provide saliency through realistic, detailed descriptions but should also avoid embedding or anchoring to a reference good. The implementation of CV has been thoroughly discussed in the environmental economics context [11–13], but issues specific to health require further study, especially given concerns in the health economics literature regarding responses to hypothetical scenarios [8,14–16]. Most health economics CV studies do not conform to existing guidelines for a robust CV study [8,14]. Smith [8] finds that the hypothetical devices in 111 previous studies were poorly constructed and described. A valid CV study for environmental [6,11–13] or health outcomes [17–19] requires a hypothetical scenario that is realistic to the respondents and a sample that is representative of the population of interest.

We explore these methodological issues through a study of childhood asthma. There has been little research estimating WTP to reduce asthma morbidity for children. Rowe and Chestnut [20] used a broad scenario eliciting willingness to increase taxes to "set up programs that could reduce pollens, dusts, air pollutants, and other factors." Some studies on adult asthma [21–23] used CV to elicit WTP for hypothetical medications that would eliminate asthma symptoms or cure asthma. But these studies are in many ways flawed: it is difficult to disentangle preferences for air quality improvement from reductions in asthma morbidity [24]; survey responses include unmeasured bias against medications; the sample of respondents may not accurately represent the entire population of child asthma cases; and because improvements in our understanding of asthma suggest that a complete cure is not credible, the hypothetical presented is unrealistic. Furthermore, these scenarios do not value the broader psychosocial burden—uncertainty, daily management—associated with asthma, and therefore do not address the real-life experiences of respondent households. The stress caused by lacking control over one's health can have a detrimental effect on a broad range of outcomes [25–27].

Methods and Application

We examine four essential components of a credible health valuation study.

Population of Interest

Studies show substantial disparities by race/ethnicity and income in asthma-related hospitalizations, emergency room visits, and school absences [28–30]. For these reasons, it is important to base valuation estimates on a sample that reflects the increased prevalence of asthma morbidity among minority and low-income households. The consensus approach is to sample individuals who are personally familiar with the health outcome [14,17–19] and make household money allocation decisions. This is essential for a chronic illness, because it is difficult for someone unaffected by a disease to appreciate its full impact on the quality of personal and family life. Our approach is consistent with that of previous studies that value the impact of a health intervention on both the child's health and the overall quality of family life [31,32]. Last, theoretical models suggest that parents are appropriate proxies for children [10], and the difficulties of administering a CV survey to children render doing so impractical.

Like Rowe and Chestnut [20] and Dickie and Gerking [33], we administered two economic surveys (a revealed preference survey and a contingent valuation survey) to participants in an asthma epidemiology study. This strategy reduces sample size (because such studies typically have small enrollments) but provides easy access to the target population. We combined our economic study of household behaviors with epidemiological and demographic data collected by the Fresno Asthmatic Children's Environment Study (FACES), a 5-year epidemiological study of households with children aged 5 to 11 years with clinically diagnosed asthma living in Fresno, CA.

Qualitative Study and Scenario Development

Families vary in their WTP for improvements in their children's asthma. They also vary in their beliefs about and attitudes toward asthma [34–37], the degree to which the disease affects household quality of life [34,35,37], attitudes toward and trust in the health care sector [37–39], and their perceptions of the risk of asthma symptoms due to environmental pollution [40]. To the extent that these attitudes and beliefs are related either to WTP for medically irrelevant attributes of the valuation scenario or to standard explanatory variables, ignoring these sources of heterogeneity will produce biased estimates. Therefore, we used a preliminary qualitative study to measure these variables and designed a scenario to minimize their influence.

First, we conducted a revealed preference survey of FACES participants on four topics: health status, attitudes and beliefs, averting behaviors and their perceived risks and benefits, and socioeconomic characteristics. We supplemented the data from this survey with data from the epidemiological study on the child's asthma morbidity. Next, we conducted three waves of focus groups (four to five sessions with four to six participants each) to understand health behaviors and influences on household choices from the family's perspective. Focus groups included families in the Fresno area, Hampden and Hampshire counties in Massachusetts, and Oakland, CA. FACES participants were included in the first two waves but excluded from the third, so that we could administer the CV survey to the complete FACES cohort.

In the first wave, discussion topics were drawn from three models of health behaviors—the Health Belief Model, the Theory of Reasoned Action, and the Theory of Social Cognition—and covered perceptions regarding susceptibility to asthma, disease severity, benefits from taking action, barriers preventing action, health behaviors, and subjective norms concerning behavior. In the second wave, we developed a specific hypothetical product to be used in the CV scenario. The hypothetical product was inspired by two products consistently mentioned by parents: the pulmonary function tests used in the epidemiological study and the fingertip oxygen monitor used in medical offices. In the third wave, we identified the questions or concerns that respondents might have about our product, and we tested different hypothetical versions of it to minimize complicating issues.

This qualitative study provided three important lessons. First, the nonmarket welfare effects of asthma include both acute symptom episodes (physical effect) and the chronic stress caused by the lack of control over the disease (psychosocial effect).

Respondents described the need for more information about their child's asthma status and discussed how uncertainty affected their lives. Second, households in our population harbored negative views of medications and strong opinions about their possible side effects. These attitudes toward medication are evident in many other health studies. Third, the households sampled were already engaged in a wide range of efforts to reduce asthma episodes and generally felt that adding new activities or changing routines was cumbersome and unattractive.

Hypothetical Scenario

In light of these considerations, we chose to present a product that is used by the family rather than a change that is external to the family (such as a shift in public policy). This avoided two sources of unobserved heterogeneity: perception of the policy's efficacy and perception of the child's responsiveness to the intended change (e.g., reduction of pollution). To avoid confounding the WTP response with preferences for different types of health care, we decided not to include medication in our hypothetical. We chose a scenario that did not require substantial behavioral changes because participants may have varying perceptions of their ability to change behavior. While the hypothetical device requires some small behavioral changes, such as wearing the device (which is similar to a wristwatch, described below) or adapting to a new asthma "monitoring system," households would not need to make environmental changes or use new medical treatments. In the focus groups, pilot survey, and final CV survey, families did not express concern that substantial behavioral changes would be required. Finally, we designed our scenario to target both physical asthma symptoms and the stress caused by uncertainty.

The hypothetical product we offered was a "BreatheRight" oxygen monitor, worn like a wristwatch, which would provide immediate, objective information about the child's asthma status (blood oxygen level). This product was similar to the fingertip oxygen monitor that our population was familiar with and did not require expending more time on asthma management (e.g., taking medication, reducing triggers). This asthma watch would not only help families address medical symptoms but also provide information to reduce uncertainty and stress. The scenario included two optional, free services to deliver timely information: ParentAlert, which notifies a guardian when the monitor has changed to yellow or red, and ActionAlert, which notifies the child's physician.

In the final CV survey, individuals were presented with a product brochure (a copy of the survey is available from the authors on request). The brochure reviewed the two medical components of asthma—inflammation and constriction—and compared the watch to the actual oxygen monitor used in emergency rooms in order to provide to participants a meaningful reference. The brochure stated, "Children who wore the watch had 50% fewer days with asthma symptoms" and "With BreatheRight you know if asthma is affecting your child's airways. Monitoring with BreatheRight allows you to take prompt action and decreases asthma symptoms." The interviewer reminded the respondent of the number of symptom-days she had previously reported and the number of symptom-days the watch would be expected to prevent. The respondent was then asked whether she would be willing to pay certain specific amounts for the watch; the price was presented as both monthly payments and an annual total.

We used focus groups and the pilot survey to establish a reasonable range of prices. Using an open-ended format, we asked families to state how much they would be willing to pay for the device. In the first round of pilot tests, we wrote on index cards a range of prices from the minimum to the maximum given in the focus groups. Respondents were asked to sort the prices into those they would not be willing to pay and those they would be willing to pay. We used this approach to approximate the randomly shuffled payment card method, which has been suggested for contingent valuation in health [41]. These prices were tested in the pilot survey to generate the prices offered in the final CV survey.

Econometric Model

Our survey identified people who were interested in the watch and those who were not. Only the former were presented with a price; the interviewer then recorded their responses to a one-and-one-half-bounded dichotomous choice [42]. In this approach, a respondent is given two prices up-front and told that the exact cost of the item lies within the range bounded by these two prices. Of the two prices, one is selected randomly and the respondent is asked whether she would be willing to pay it; she is then asked whether she would be willing to pay the other price, but only if this would be consistent with her initial response. These responses provide a range for her WTP. All possible responses can be summarized in three groups: (no, no), where the respondent is unwilling to pay even the lower price; (yes, no), where she is willing to pay the lower but not the higher price; and (yes, yes), where she is willing to pay the higher price (econometric details in [42]). The one-and-one-half-bounded [42] has been shown to reduce some inconsistencies found in the double-bounded format without compromising statistical efficiency.

We estimated the mean WTP for the sample by using both a nonparametric and a parametric probability model with a linear functional form for the utility function [43]; because results were not qualitatively different, we report them only for the parametric estimation. Some respondents were not interested in the device; we address this with three models. First, we excluded the 18 respondents who were not interested and estimated the discrete choice models only for the others (model 1). Second, we coded these 18 responses as saying "no" to any bid (model 2). Third, we used these individuals to define a spike at zero (model 3). For each model, we compared three specifications: 1) a simple model with the bid as the only explanatory variable, 2) a model that adds health status and beliefs to the bid, and 3) a full model that also includes sociodemographics.

Results

Survey Data

Descriptive statistics for the population and sample are given in Table 1. FACES completed a total of 315 baseline interviews ("Full FACES" column in the table). A total of 222 households completed the baseline, provided complete epidemiological survey data, and were also English-proficient. Of those households, 73 declined to take the CV survey ("Active FACES, decline CV" column), leaving 149 participants who completed the CV survey and provided complete epidemiological data ("CV" column). The CV survey was administered in person by FACES employees in FACES offices to the single family member primarily responsible for making health care decisions for the child, without the child present.

The children covered in our data range in age from 7 to 17 years, with a mean age of 12.5 years. The larger proportion of black/African-American participants in FACES relative to the Fresno population likely reflects the difference in prevalence in the California population [30]. The "CV" group contains a larger proportion of whites, a smaller proportion of Hispanics, and slightly more African Americans than the "Active FACES, decline CV" group. We believe that this difference is a consequence of our administering the survey only in English, whereas the FACES

Table 1 – Study sample.

	Fresno County	Full FACES baseline (n = 315)	Active FACES, decline CV (n = 73)	CV (n = 149)
Race/ethnicity				
White	39.7	41.9	41.1	47.7
Hispanic	44.0	39.7	43.8	30.9
Black/African American	5.3	15.6	13.7	15.4
Other/missing	NA	2.8	1.4	6.0
		(n = 315)	(n = 73)	(n = 149)
Own home	56.5	56.5	55.7	53.0
		(n = 294)	(n = 70)	(n = 125)
Maternal caregiver has high school degree or higher	69.0	84.9	88.7	89.9
		(n = 311)	(n = 71)	(n = 145)
Income				
Less than 30,000	43.2	45.4	50.7	30.6
31,000–50,000	23.1	25.0	17.8	25.9
More than 50,000	33.7	29.6	31.5	43.5
		(n = 304)	(n = 73)	(n = 147)

Statistics for the full FACES baseline are from Tager et al., Fresno Asthmatic Children's Environment Study (FACES) Final Report (ARB Contract Nos. 99-322). Sacramento, CA: Research Division California Air Resources Board, 2006. *Note*. Because of missing observations for some variables, the sample statistics have slightly smaller sample sizes than the number of observations (304 of the 315 "Full FACES" group and 147 of the "CV" had no missing data). CV, contingent valuation; FACES, Fresno Asthmatic Children's Environment Study; NA, not applicable.

surveys were administered in English or Spanish. Our sample is more representative of families affected by asthma than the samples used in the previously cited studies.

Estimation Results

The set of prices offered for the watch was (5, 15, 20, 30, 55, 60, 65, 80, 90, 100, 125). A total of 153 CV surveys were completed (149 with complete data on covariates of interest). Of the 153, 18 respondents (11.76%) did not want the watch, 56 (36.60%) were willing to pay the higher price, 50 (32.68%) were willing to pay the lower but not the higher price, and 29 (18.95%) were unwilling to pay either price.

Descriptive statistics for our explanatory variables are given in Table 2. Results of the parametric models are presented in Table 3. In all models, the bid variable is of the expected sign and

Table 2 – Descriptive statistics and definitions of explanatory variables.

Name	Definition	Mean ± s.d.
Health Status		
Overall health	Overall health of child: 1 for excellent or very good.	0.570 ± 0.497
Bad days	Number of bad days with asthma: 1 for fewer than two a month.	0.564 ± 0.498
Length	Length of time since last bad day: 1 for less than 3 months.	0.503 ± 0.502
Severity of asthma	Severity of asthma in general: 1 for the lowest level.	0.362 ± 0.482
Severity of attacks	Severity of an attack: 1 for the lowest level.	0.081 ± 0.273
Symptom frequency	Number of days with symptoms in past 30 days.	8.430 ± 7.265
Attitudes and Beliefs		
Prevent attack	Do they think they can prevent an attack? 1 for yes.	0.617 ± 0.488
Control attack	Do they think they can control an attack once started? 1 for yes.	0.383 ± 0.488
Worry	Do they worry about asthma between episodes? 1 for often or sometimes.	0.671 ± 0.471
Typical	Are current symptoms typical for child? 1 for yes.	0.624 ± 0.486
Asthma rank	Do they rank asthma as the primary stressor? 1 for yes.	0.322 ± 0.469
Asthma parents	Has a parent been diagnosed with asthma? 1 for yes.	0.443 ± 0.498
Triggers	Do parents report that physical activity is a trigger for asthma? 1 for yes.	0.403 ± 0.492
Demographics		
Income	Is income < $40,000/y? 1 for yes.	0.611 ± 0.489
No Rx	Has child foregone a RX because of price? 1 for yes.	0.255 ± 0.437
Financial stress	Do they rank family finances as primary stressor? 1 for yes.	0.235 ± 0.425
Race	Does parent report white/Caucasian as child's race/ethnicity? 1 for yes.	0.477 ± 0.501
Mother's education	Does mother have less than high school education? 1 for yes.	0.074 ± 0.262
Gender	Is child male? 1 for yes.	0.642 ± 0.482
Parents' overall health	Is parent in excellent health? 1 for yes.	0.174 ± 0.381

Rx, treatment.

Table 3 – Parametric models.

Category	Variable	Model (1) Excluding WTP = 0			Model (2) WTP = 0 are no-no			Model (3) Spike model		
		A	B	C	A	B	C	A	B	C
Cost variable	Constant	2.925*	2.030*	2.402*	2.370*	1.619*	2.313*	1.827*	0.998*	1.846*
	t value	(9.263)	(3.968)	(2.734)	(9.884)	(3.62)	(2.766)	(8.395)	(2.298)	(2.325)
	BID Bid	− 0.0453*	− 0.049*	− 0.0493*	− 0.0419*	− 0.0492*	− 0.0495*	− 0.033*	− 0.0379*	− 0.0382*
	t value	(− 9.781)	(− 9.768)	(− 9.755)	(− 11.297)	(10.978)	(− 10.986)	(− 10.101)	(− 9.936)	(− 9.94)
Health status	Overall health	—	− 0.224	− 0.125	—	− 0.603†	− 0.532*	—	− 0.619†	− 0.537
	t value	—	(− 0.588)	(− 0.318)	—	(− 1.682)	(− 1.453)	—	(− 1.773)	(− 1.496)
	Symptoms	—	0.054	0.055	—	0.078†	0.0817†	—	0.075†	0.081†
	t value	—	(1.11)	(1.118)	—	(1.665)	(1.735)	—	(1.658)	(1.772)
Attitudes and beliefs	Control attack	—	0.525	0.503	—	0.764*	0.794*	—	0.800*	0.839*
	t value	—	(1.405)	(1.324)	—	(2.197)	(2.272)	—	(2.360)	(2.453)
	Worry	—	0.767†	0.828*	—	0.938*	0.963*	—	0.897*	0.935*
	t value	—	(1.909)	(2.023)	—	(2.578)	(2.618)	—	(2.522)	(2.592)
	Asthma rank	—	0.762†	0.765†	—	0.807*	0.820*	—	0.740†	0.739†
	t value	—	(1.855)	(1.801)	—	(2.016)	(1.978)	—	(1.941)	(1.875)
Sociodemographics	Age	—	—	− 0.028	—	—	− 0.061	—	—	− 0.078
	t value	—	—	(− 0.414)	—	—	(− 0.992)	—	—	(− 1.308)
	Race	—	—	− 0.160	—	—	− 0.037	—	—	− 0.026
	t value	—	—	(− 0.421)	—	—	(− 0.11)	—	—	(− 0.079)
	Mother's education	—	—	− 0.793	—	—	− 0.665	—	—	− 0.520
	t value	—	—	(− 1.121)	—	—	(− 1.028)	—	—	(− 0.817)
	E Estimated spike	—	—	—	—	—	—	0.139	0.108	0.108
	N	131	131	131	149	149	149	149	149	149
	Log-likelihood	− 144.23	− 136.37	− 135.63	− 192.50	− 176.39	− 175.41	− 187.42	− 171.53	− 170.35
Mean monthly WTP		64.62	64.84	64.79	56.48	56.60	56.52	60.67	59.76	59.69
SD		3.84	3.68	3.68	3.80	3.37	3.37	4.45	4.06	4.07
Average WTP per day of symptoms		17.05	17.11	17.10	14.90	14.93	14.91	16.01	15.77	15.75
WTP assuming asthma rank = 0 and worry = 0										
Mean monthly WTP			48.27			38.52			40.67	
Mean WTP per day of symptoms			12.70			10.33			10.90	

Note. Columns "A" include only the price of the hypothetical good as an independent variable. Columns "B" include price and asthma beliefs. Columns "C" include the price, beliefs, and sociodemographics.

WTP, willingness to pay.

* $P < 0.05$

† $P < 0.1$

statistically significant. The mean WTP for the reductions in asthma morbidity calculated from the parametric models ranges from \$56.48 ± \$3.80 to \$64.84 ± \$3.68 per month. To address yea-saying, we recalculated the WTP by using a 10-point certainty calibration scale [44]. "Yes" responses that were followed by a certainty level of less than 8 were recoded as "no" responses. The mean WTP values for our models remained similar, ranging from \$48.58 to \$56.72. The difference between the original and recalibrated WTP ranged from \$5.91 (in the spike model with all covariates) to \$8.27 (model 1 with only price): there was significant overlap in the 95% confidence interval for many of the models.

Scenario Validity

Our survey extensively asked respondents to describe their perceptions of the product and the reasons for their choice. The overwhelming majority reported only asthma-related benefits as the basis for the decision, with reduced stress from improved information a prevailing theme. Of the 135 households willing to buy the watch, the vast majority cited as motivation decreased uncertainty, peace of mind, reduced worry, or similar benefits. Participants valued improved information because it would reduce anxiety about the child's health. Of those stating that they would buy the watch, 87% opted for ParentAlert (alone or with ActionAlert). People reported that this service would help them monitor the child's health, provide peace of mind, reduce worries, and reduce stress. The only reported nonasthma benefit was that the watch would also tell time. Only three respondents reported concerns about accuracy; only four reported that they were uncertain whether, for fashion reasons, their child would be willing to wear the watch. It is plausible that the age of the child might affect the parent's perception of the efficacy of the monitor; however, the age of the child was not statistically significant in our model.

Of the 18 respondents who were not interested in the product, only two expressed concerns about its effectiveness. The others were "not interested" because their child's asthma was mild or under control. The primary reasons given for not buying the watch at the offered price were that the child's asthma was not significant enough to warrant the purchase and that the household budget was limited. Of those who declined the watch, 63% would have bought it at another time when the child's asthma was worse than at the time of the survey. These responses indicate that the WTP elicited by the scenario was predominantly based on asthma-related impacts and that the scenario had a high degree of acceptance.

Our estimated WTP was also consistent with observed household behaviors. Expenditures on asthma-related goods, including supplies for reducing triggers, medications, and the amortized cost of durable goods, are highly right-skewed with a median of \$492.75 a year or about \$41 a month (mean = \$644.67 ± \$499.92, range \$0–\$2490.85). The median proportion of household income spent on these goods was 1.1% (mean = 2.6% ± 4.2%). The median income share for our WTP estimates is 1.5% (mean = 2.4% ± 1.9%). This convergent validity increases our confidence in the estimates.

Discussion

Our results reveal how asthma affects household decisions. WTP decreases if the child has a higher level of overall health. WTP increases if asthma is ranked as a primary stressor, the respondent feels able to control an asthma attack once it starts, or the respondent worries about the child's asthma between episodes. Symptom frequency is positively associated with WTP, but its coefficient is substantially smaller than those for "control attack," "worry," and "asthma rank." Of particular interest is the contrast between the variables that were significant and those that were not. Remarkably, measures of symptom frequency were not significant. In the health economics literature, health status is typically measured by using objective disease characteristics such as symptom frequency or some measure of health care utilization. These variables, however, do not accurately reflect how a family experiences the disease. Our results show that WTP depends less on objective severity measures and more on attitudes and beliefs, such as the degree of worry between attacks and the importance of asthma as a family stressor.

As with any CV study, these results require several qualifications. First, some parents might have felt obliged to inflate their WTP because they were asked in person about a product that could improve their child's health. The NOAA guidelines [11] and summaries of best practices [11,45,46], however, suggest that in-person interviews are preferable to other approaches. We reestimated WTP by using a numerical certainty scale [44] and retaining positive responses only from those participants who were highly certain of their answers; this yielded similar results. Second, CV studies are subject to the incompatible incentive dilemma. A respondent might misreport her true WTP if she believes that her response affects the provision of policy or programs [6]. The consensus in the CV literature is that this problem is avoided by using a binary discrete choice format with a take-or-leave-it question that is resistant to such biases [6,47], as we did in our survey. Third, sample selection is a common issue in observational studies. The sociodemographic characteristics of our sample, however, do not vary systematically from the population of interest: households in Fresno with children with asthma. Fourth, our sample size was limited, as is common in epidemiological studies [48,49]. Other possible strategies might yield a greater sample size but would make it harder to follow up with respondents or to link the CV survey with epidemiological data. Given that the sample reasonably approximates the population of interest, we felt the advantage of detailed data outweighed the benefits of a larger sample.

Conclusions

Public health policy requires accurate cost-benefit analyses, which require accurate valuations of the health outcomes targeted by policy. However, valuations of the disutility caused by chronic illnesses typically suffer from a variety of shortcomings, including unrealistic scenarios, confounding of preferences for health outcomes with preferences for other scenario attributes, and failure to capture the psychosocial effects of illness in addition to its physical effects.

Our contingent valuation study estimates parental WTP for reduced asthma severity in children. We calculate a mean WTP of \$56.48 to \$64.84 per month for the benefits provided by our scenario. This estimate can be used to quantify the benefits of policy initiatives related to asthma. Our estimate goes beyond previous studies because it incorporates both the disutility of physical symptoms and the disutility caused by uncertainty and stress.

In addition, our study provides detailed new guidance on how to construct a CV scenario for a chronic illness. We used household perceptions of health states and of the factors that affect health states to inform our CV scenario, to make it credible to survey participants, and to ensure that participant choices were not unduly affected by unintended attributes of the scenario. Household perceptions and beliefs, such as perceptions of the overall burden that asthma places on a family, had a larger impact on valuation than traditional measures of asthma severity.

Our approach can be applied to other chronic illnesses, such as diabetes or chronic pain, with which asthma shares several important characteristics: frequency and severity fluctuate over

time; health outcomes depend on both exogenous factors and individual behaviors; in general, the impact on quality of life is determined less by physiological severity than by the family's experience of the disease; and both disease prevalence and the value placed on disease mitigation vary across subpopulations. These characteristics make it difficult to value reductions in morbidity from chronic illnesses; it is important to develop "best practice" guidelines similar to those in environmental economics [11,45,46]. This article shows how detailed fieldwork and empirical modeling can be combined to overcome these challenges and derive reliable valuations of the impact of chronic illnesses.

Acknowledgments

The authors thank the lead researchers of the Fresno Asthmatic Children's Environment Study—Dr. Ira Tager and Dr. Kathleen Mortimer—for their valuable input. Without their collaboration this research would not have been possible.

Source of financial support: This research was funded through the US EPA-STAR Valuation of Human Health Program (R-82966501, Valuing Reduced Asthma Morbidity in Children). The project FONDECYT 11090005 provided partial support for Felipe Vasquez. This article has not been formally reviewed by the EPA. The views expressed in this document are solely those of the authors, and the EPA does not endorse any product or commercial services mentioned in the publication.

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